National Nuclear Security Administration

The Essential Role of Credible Correct Simulation in Assuring the Safety of America's Nuclear Stockpile

Foundation 02

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October 22, 2002

NNSA Mission

Strengthen United States security through the military application of nuclear energy and by reducing the global threat from weapons of mass destruction.

The Nuclear Weapons Complex

The Production Complex

Pantex Plant

Kansas City Plant

Y-12 Plant

Savannah River Site

The Defense National Laboratories and Test Site

Sandia

Nevada Test Site

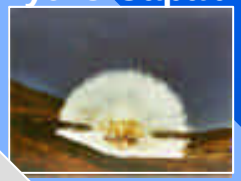
Los Alamos

Lawrence Livermore

Stockpile Stewardship R&D
Strengthening Science-Based Methods

Theory and Simulation

Adv. Hydro Capability



National Ignition Facility

Arming, Fuzing, Firing

HE Detonation

Implosion

Fission Burn

Boosted Burn

Radiation Flow

Implosion

Burn/Explosion

Effects

Nuclear Output

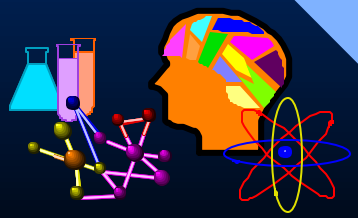
Assessment and Certification

Primary Initiation

Primary Yield

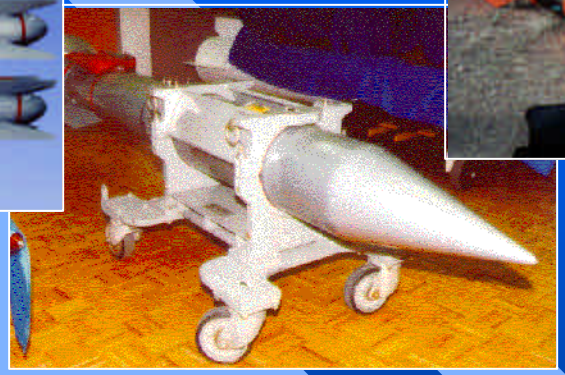
Secondary Yield

Safety/Security/Use Control…System Integration (Stockpile to Target)



Materials and Chemistry

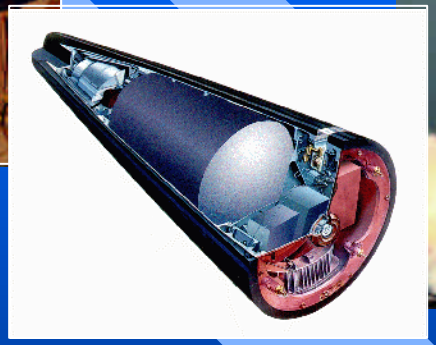
U.S. Nuclear Weapons Stockpile*



*Active stockpile only, does not include the W84

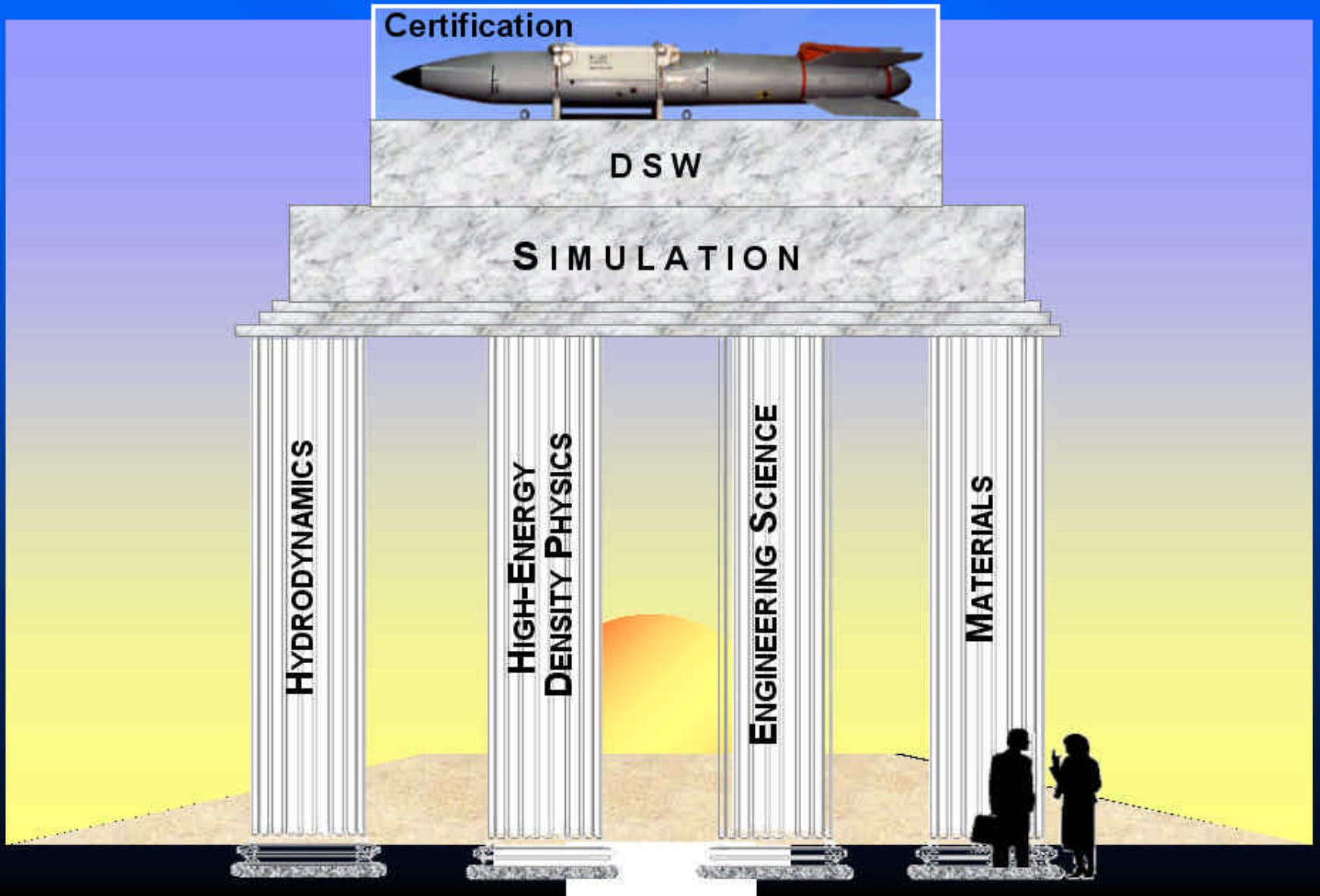
	B61-3/4/10	B61-7/11	B83	W80-0/1
Description	Non-strategic Bomb	Strategic Bomb	Strategic Bomb	TLAM-N Warhead ALCM/ACM
Delivery system	F-15, F-16, NATO Tornado	B-52, B-2	B-52, B-2	SSN Attack Submarine B-52, B-2
Labs	LANL & Sandia	LANL & Sandia	LLNL & Sandia	LANL & Sandia
Primary use	Air to Surface	Air to Surface	Air to Surface	Underwater to Surface Air to Surface
Service	Air Force	Air Force	Air Force	Navy, Air Force
Date entered stockpile	10/79, 8/79, 8/90	9/85, 11/97	9/83	3/84, 2/82

U.S. Nuclear Weapons Stockpile



	W62	W78	W87	W76	W88
Description	ICBM Warhead	ICBM Warhead	ICBM Warhead	SLBM Warhead	SLBM Warhead
Delivery system	Minuteman III	Minuteman III	Peacekeeper	Trident I (C4) Trident II (D5)	Trident II (D5)
Labs	LLNL & Sandia	LANL & Sandia	LLNL & Sandia	LANL & Sandia	LANL & Sandia
Primary use	Surface to Surface	Surface to Surface	Surface to Surface	Underwater to Surface	Underwater to Surface
Service	Air Force	Air Force	Air Force	Navy	Navy
Date entered stockpile	4/70	9/79	7/86	11/78	6/89

Pillars of Science Converging on Certification



What do we need to do?

- **Ensure the safety, security, reliability and effectiveness of the stockpile without testing:**
  - Conduct annual assessments for certification
  - Detailed understanding of weapons physics and materials aging
  - Conduct surveillance, predict and find problems, develop solutions
  - Refurbish weapons well before aging degrades safety and reliability
- **Design, develop, manufacture, and certify new weapons, in response to new national requirements.**
- **Respond rapidly and decisively to changes in the security environment.**
- **Maintain timely ability to conduct nuclear test, if required.**

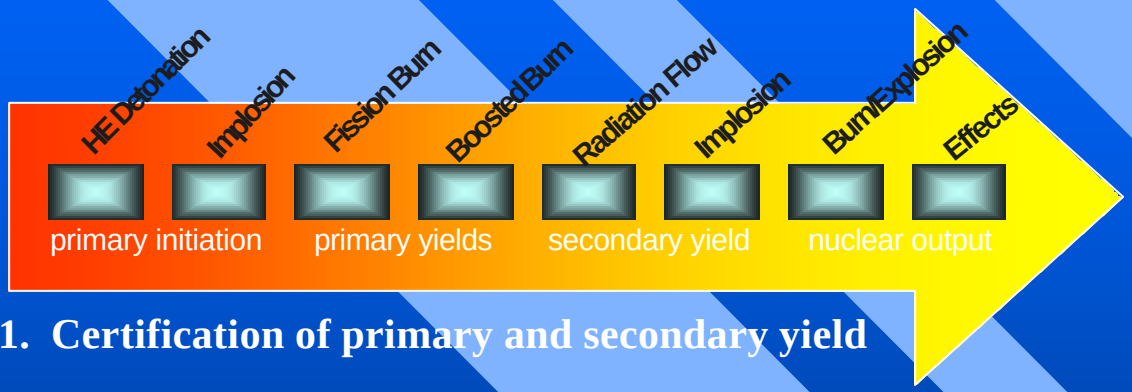
DETERRENCE THROUGH:

- ✓ **Being capable**
- ✓ **On-going, visible surveillance/certification**
- ✓ **Demonstrated capability to respond to new requirements**

Leading Edge Technology
in
Modeling & Simulation
is
our Answer

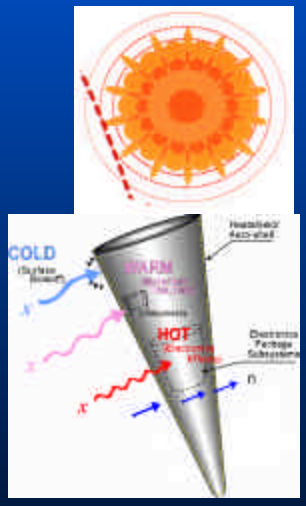
Our M&S Investment Program: ASCI

ASCI will Deliver 3-D Codes Capabilities

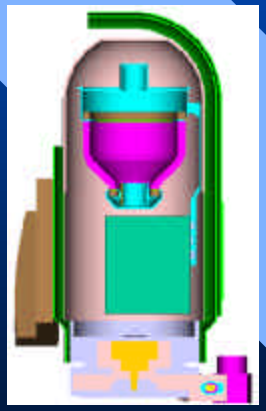


1. Certification of primary and secondary yield

2. Certification of weapons in normal environments



3. Certification of weapon components in hostile nuclear environments



4. Manufacturability of refurbished components

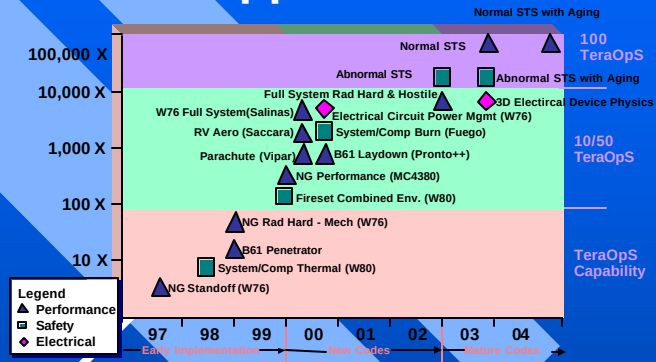
5. Evaluation of safety of nuclear weapons in accident environments

Simulation Requires a Large Supporting Infrastructure

Platforms

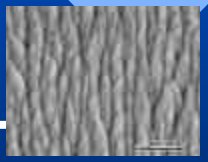
Distance & distributed computing

Applications



Problem Solving Environment/Post Processing

simulation

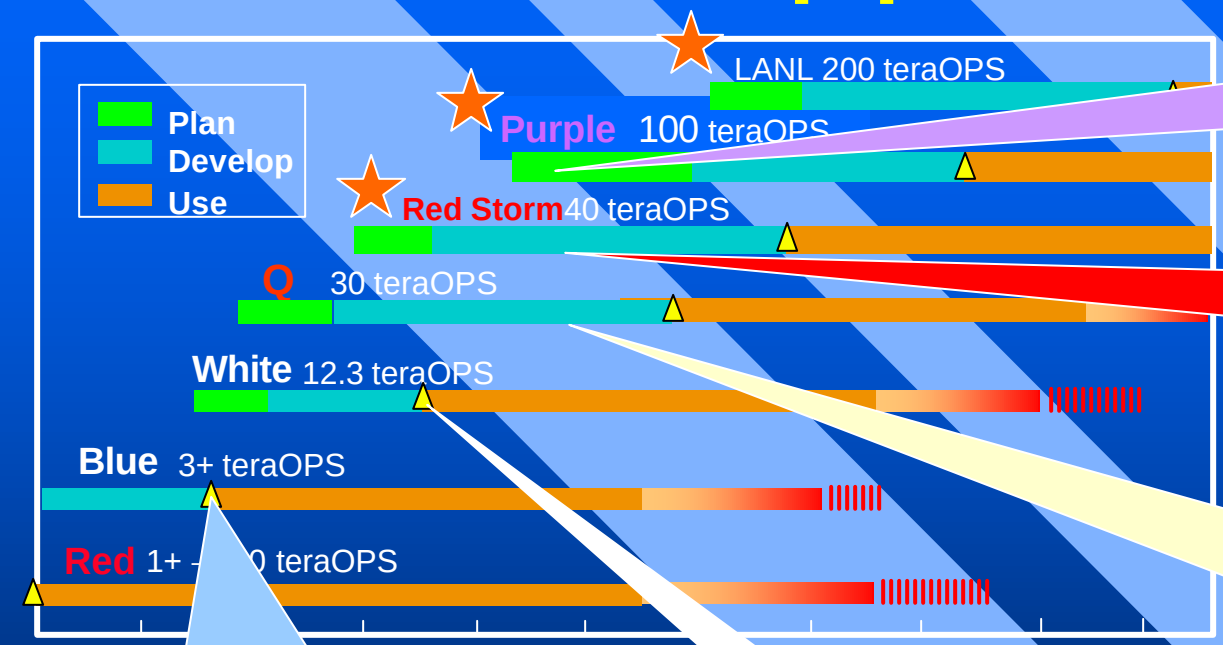


Material & physics models

Experiments

Verification & validation

Newer, more powerful platforms are in the pipeline



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One-billion-atom molecular dynamics simulation movie

Multiscale modeling allows us to envision new roles for computational materials science

The Future?

Stewardship: unprecedented resources and dependence on simulation computing.

These capabilities and their value will drive other endeavors to similar solutions